

Significance of Rhizosphere in Tea Gardens

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ABSTRACT

The lush green undulated terrain of Darjeeling covered with tea gardens is famous throughout the globe for its excellent aroma and taste. The best quality tea is produced in Kurseong hill area under Darjeeling. Experimental analysis on monthly basis was done regarding microbial population in the selected tea gardens. Interactions among certain microorganisms were analysed during the study. Coordination in between specific microbes might also be responsible for the impact. Fungi, bacteria and actinomycetes – these three groups of microbes were tested during the process. Results showed that neo tea plant rhizosphere and rhizosphere of several other perpetual plants, of various ages, flourishing in age old tea gardens, seemed to expediate growth of microbes. At present,

tea rhizosphere has been tested thoroughly, specifically in relation to plant-microbe response. Counter to the common outcomes, rhizosphere and soil comparisons were happened to be continuously below 1. The edaphic samples were gathered from vintage tea estates which showed negative impact of rhizosphere. Finding of 'negative rhizosphere effect' in old tea bushes is a significant and a novel nature of tea rhizosphere. Supremacy of a certain population of microbes, affinity towards a section of general opponents, constitutes a good instance of reciprocated selection in natural environment. These discoveries have unlocked newer paths for extended researches in the field of 'rhizosphere microbiology'. Present study is an attempt to evaluate the transforming features and significant implications in the tea industry.

Keywords: rhizosphere, tea, garden, estate, soil, microorganism, population

INTRODUCTION

The Darjeeling logo is a hallmark of excellence. Launched in 1986, the Darjeeling logo has come to represent high quality muscatel flavored tea with the unmistakable class that only Darjeeling can offer. The logo is a significant landmark in the history of the tea industry. Conceptualized by the Association of

Darjeeling Tea Gardens and launched in the international and domestic market by the Tea Board, it guarantees genuine Darjeeling Tea, tested and packed for the connoisseurs of tea throughout the world [3]. The Darjeeling tea industry is a happening place and has more surprises to furnish. The Darjeeling Tea Research Institute is located on Pankhabari Road of Kurseong. Kurseong still applies the traditional basic model of tea manufacture, known as the “Curling, Tearing and Crushing”, popularly known as C.T.C [1]. Presently, organic tea is the most famous name given to tea grown using chemical free manure and eco-friendly practices. There is no use of chemical fertilizers and pesticides in an organic tea garden [2].

MATERIALS & METHODS

Regular assessment of various microbial growth in soils growing tea in terms of units making of colony have been executed by the process of plate-count. Three separate soil depths were analysed for the span of 1 year. The examination was done on three groups of bacteria, fungi and actinomycetes [4]. The samples were collected from tea gardens which clearly indicates an overall negative effect of rhizosphere. This negative effect can also be caused by specific microorganism living together [5]. It can be

assumed that the rhizosphere of relatively new tea bushes and of various perennial plants having variety in ages generally developed in tea estates which are already established, could have accelerated microbial growth [6]. The -ve impact of rhizosphere of relatively much aged tea gardens do not seem to be a regular incident like growing old in normal condition but could be one of its kind and specific to tea plants [7].

Several experiments were conducted by gathering edaphic samples from various sites of the country [8]. The results showed various distinguishing characteristics. Tea gardens from where samples were collected are situated in the eastern Himalayan region are characterized with the quantity of rainfall, even some experience snowfall [9].

The initial experiments, which were carried out at Makaibari tea experimental garden and Castleton tea estate, both in Darjeeling District under Kurseong Subdivision of West Bengal, gave interesting and thought provoking outcomes. Investigations were carried out for a time period of one year, at monthly interval in Makaibari tea estate, which assured the propagation of rhizosphere microbial populations of relatively new tea plants as primarily expected [10]. On the contrary, already

established tea bushes with rhizosphere was found to hinder growth of microbes as observed in terms of the microbial population in the area infested by rhizosphere and microbial population of non-rhizosphere area [11]. Microbial analyses of samples obtained from the soil of Castleton tea estate, where the bushes were of assarnica type and the plantations were more than twenty years old which also showed strong inhibition of rhizosphere microbial communities [12].

Out of the microbial communities, namely - actinomycetes, bacteria and fungi, bacteria were the maximum subdue group among the matured tea rhizosphere. Fungal and Actinomycetes populations were also suppressed but to a much lower extent. The stimulation of microbes in the rhizosphere ("rhizosphere effect") due to plant roots is a popularly known and normal phenomenon and indicates a "positive" influence of plant roots on rhizosphere microorganisms. It is an important observation and is against the general norm. Similar experiments were also

conducted from various tea gardens to justify the status of rhizosphere effect in established bushes [13].

RESULTS AND DISCUSSION

The soil samples were obtained from various locations (1) Rohini tea estate (2) Ambootia tea estate and (3) Goomtee tea estate. The tea bushes were of various age groups. While Rohini and Ambootia tea estates represented the well-maintained tea plantations, Goomtee tea estate was not used for a long time. It has been observed that in most of the cases, the R:S showed same trend as received from Makaibari tea plantations, except in case of estimations of bacterial populations from Rohini tea estate, that showed inhibitory effect even at 4years of age [14]. All the tea gardens under discussion are situated in the Himalayan range representing the subtropical or temperate conditions which are generally characterized by rainfall and or snowfall (*Table I*).

Table 1 Comparative data of age of tea plants and climate in different study areas

Study Area	Age of tea plants	Altitude in m above mean sea level	Mean monthly temperature in degree Celsius		Total rainfall in millimetre
			Maximum	Minimum	
Rohini Tea Estate	4, 8, >100	1300	25.5	13.5	2400
Ambootia Tea Estate	>30	1400	23.5	13.5	2300
Goomtee Tea Estate	4, 15	1600	20.5	8.5	1800
Makaibari Tea Estate	32,44,123	1400	18.5	14.5	2100
Karbia Tea Estate	>100	1577	23.5	10.5	1100

The 'negative rhizosphere effect' was more prominent in sophisticated tea estates rather than abandoned tea estates. This was found from two tea gardens, known as (1) Selim Hill tea estate, where from different quantity of soil samples were taken developing along the borders of the tea estate and (2) St. Mary's tea garden having the detreated. Some recent observations performed from an immature tea estate at Karbia, impact of rhizosphere found to be

positive in nature in case of actinomycetes and fungi. Various factors that might be responsible at Selim Hill tea estate in terms of minimizing the population of microbes [15].

CONCLUSION

Tea is the main plantation crop in Kurseong hill area, and the finest qualities of tea are produced here. Tea is one of the tourist attractions of this region. With the

enhancement of eco-tourism, tea-tourism would also play an important role towards more and more revenue generation. Research and developmental activities have been done to estimate in which way the microbes are associated along with the tea plantations in various tea estates. Several thousand lakhs of microbes live in close association with the soil and plants in tea gardens. This is almost similar with the microorganisms inside the human body. Tea-tourism, if appropriately organized, is expected to upgrade the livelihood of workers of tea gardens. Through tea-tourism, visitors to the tea estates will purchase local handicrafts, folk medicines and can have the essence of local cuisine which will further pave the opportunity for more national and international tourists ultimately benefiting local people.

The target is to be able to rebuild the rhizosphere community which is synthetic in nature and can be utilized to enhance water harvesting efficiency, management of nutrients and sustainability towards climate change. Eco-huts, eco-village concept may further be encouraged in the tea estates throughout Kurseong sub-division for further betterment of eco-tourism. With the help of metagenomic techniques several microbial species associated with bulk soil, root endophytes and rhizosphere soil of tea

plantations were analysed having a background. From different results and data obtained, it has been observed that almost eighty percent of the tea rhizosphere and fifty four percent of the tea root endophyte were unclassified, and which may be part of unculturable section. As a matter of fact of the inability to predict their metabolic needs, these microbes are unculturable.

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